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ABSTRACT

This manual is designed for use in training commercial pesticide applicators. It gives identification and control information for common lawn and turf diseases, insects, nematodes, weeds, and vertebrate pests. It also discusses phytotoxicity, environmental concerns, and application methods. (BE)

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pesticide applicator training manual

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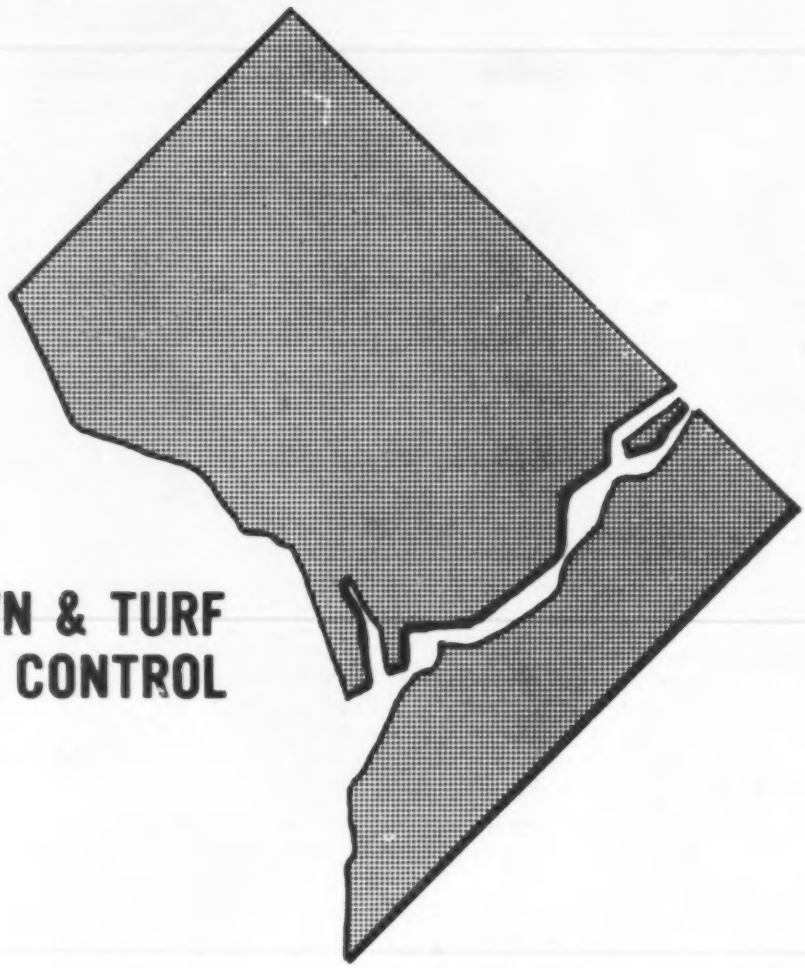

LAWN & TURF PEST CONTROL

University of the District of Columbia
Cooperative Extension Service
1351 Nicholson Street, N. W.
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LAWN AND TURF PEST CONTROL

[A GUIDE FOR
COMMERCIAL APPLICATORS]

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This training manual contains basic information to meet the standards of the Environmental Protection Agency for the certification of pesticide applicators. It prepares you for an examination of category A and subcategory 2 given by the Department of Environment Services, the Lead Agency.

This manual will not furnish you with all the knowledge for lawn and turf pest control. Any additional infcrmation can be obtained from the Plant Pathology Division, Cooperative Extension Service of the District of Columbia. Lectures, short courses, publications and other educational materials will supplement this manual.

For further information, call 282-7403 or write D. C. Cooperative Extension Service, 1351 Nicholson Street, N. W., Washington, D. C. 20011.

LAWNS AND TURFS

Lawns and turfs are being used to improve the landscape, thus giving our surroundings a feeling of being alive. Millions of dollars are spent each year to grow good lawns and turf. Property values increase, soil is conserved and we tend to preserve a clean environment. We have also demonstrated that even a blade of grass can survive in places where we thought it would never grow.

In a transition zone as ours, we are faced with the uphill task of preventing and controlling disease, insect, weed, nematode and other pests.

Even with the best grass varieties and practices, disease causing agents still invade the areas while insects find their way among the best grown patches. Weeds become more than a problem when they cannot be selectively controlled and the area might warrant an entire new lawn.

Lawns and Turfs:

Pest control in turf grass includes:

- good cultural practices, and
- chemical pest control.

Turfgrass problems often result from causes other than pests. These other causes include:

- improper watering,
- improper fertilization practices,
- injury from pesticides,
- accumulation of excessive thatch,
- improper selection of turfgrass species,
- improper mowing height,
- soil that is either too acid or too alkaline, or
- an accumulation of soluble salts in the soil.

Be sure to consider these factors when diagnosing and treating turfgrass problems.

DISEASES

The major diseases of turfgrass are caused by:

- o fungi, which can cause root rots and foliar diseases, and
- o nematodes, which feed on the roots.

Stands of diseased grass may look thin and unthrifty or contain streaks or circular patches of dead grass. Some of the more common diseases of turfgrasses are:

COMMON NAME:	SCIENTIFIC NAME OF CAUSAL ORGANISM	BRIEF DESCRIPTION	COMMON GRASS VARIETIES AFFECTED
Brown Patch	PELLICULARIA filamentosa	Brown or black areas on turf which look moldy, leaves are water soaked early in the morning and may die. Grass roots remain alive; condition prevalent near trees with little air and light.	Kentucky Blue, Merion, Rye, Fescue, Zoysia
Brown Patch	RHIZOCTONIA solani	Irregularly shaped patches a blighted grass (when mowed too close). At first, patches are purple green then fade to light brown. When grass is wet diseased patches have dark, purplish margins (smoke	Blue grasses, Bent grass, Fescues, Zoysia Rye grasses

COMMON NAME:	SCIENTIFIC NAME OF CAUSAL ORGANISM	BRIEF DESCRIPTION	COMMON GRASS VARIETIES AFFECTED
		rings). When high mowing is done the blades wither and get light brown. Patches can be large. This condition is favored in high humidity (80 - 90° F) and high nitrogen fertilization.	
Dollar Spot	Sclerotinia hemeocarpa	Irregular circular pinkish patches. Leaves rot and become soft and slimy. After the grass dies, it looks bleached or straw colored.	Kentucky Blue, Merion, Rye, Fescue, Zoysia
Fading Out	Curvularia lunata	occurs in hot weather (June - Sept.). Lawn gets pale green then yellow to brown and dies. Turfs in full sun, walks and driveways are affected.	Kentucky Blue, Fescue, Zoysia
Snow Molds	CALONECTRIA nivalis Fusarium nivale TYPHULA spp.	Dead areas are on turf after snow melts. Grass can bunch up and cause death below. Other areas look dirty gray, where hard dark red bodies are imbedded in the leaves. Damage is serious if the snow falls before the ground freezes. The fungus spread by water.	

COMMON NAME:	SCIENTIFIC NAME OF CAUSAL ORGANISM	BRIEF DESCRIPTION	COMMON GRASS VARIETIES AFFECTED
Melting Out	HELMINTHOSPORIUM vagans	Eye spots (bluish black with gray or straw color). Infection may go into the sheath and kill the shoot. A severe infection may cause a general fading out of turf grass. This disease is severe during long periods of wet weather and high nitrogen fertilization.	Kentucky Blue
Blights	HEMINTHOSPORIUM spp.	Spots, dying tips	Fescues, Bent grasses, blue grasses.
Blight	FUSARIUM roseum	Brown in summer with symptoms like that of fading out. The patches are similar to those caused by other organisms but they have green tufts (frog eyes) in the center. This condition is most severe during periods of high day and night temperatures. Lush grass with deep thatch is highly susceptible.	Merion, Kentucky Blue.
Blights	PYTHIUM aphanodermatum P. ultimum	These are among the most destructive turf grass diseases. First are small irregularly shaped, water soaked greasy spots with a cottony growth in the early mornings. These conditions develop best in warm, humid weather and with high nitrogen fertilization.	Bent grass, Blue grass Rye grass, Bermuda, Fescue, Zoysia

COMMON NAME:	SCIENTIFIC NAME OF CAUSAL ORGANISM	BRIEF DESCRIPTION	COMMON GRASS VARIETIES AFFECTED
Rust	PUCCINIA graminis	Light yellow flecks on leaves. As these spots enlarge the surfaces of the leaves rupture. Dry reddish-brown pustules develop. At this stage, spots readily rub off. The yellow leaves turn tan to brown and eventually die.	Merion, Kentucky Blue, Alternate host is wild barberry
Fairy Ring	MARASMIUS oreades and Others.	Seen as circles of darker green. Often surrounded by mushrooms, toadstools, or puffballs. The green grass dies later as these fungi may prevent water from penetrating the soil.	Any variety
Slime Molds		Appear is dull gray to light blue masses of powdery growth on the surfaces of the leaves. Common during long periods of light rain fall. No serious damage is done.	

Disease Control

Disease-producing agents in turfgrasses can be minimized and, in some cases, controlled through the use of good management practices. Turfgrass fungicides are available for use as preventive sprays or granules. When an outbreak of a disease occurs, preventive fungicides should be applied immediately. After infection has occurred, the use of a preventive fungicide is directed at protecting against future infection. Timing of protective fungicide applications should be based on a knowledge of:

o life cycle of the fungus, and

o weather conditions that are best for its parasitic activities.

In certain instances, preventive use of a fungicide is warranted when the location has a history of turfgrass disease. The routine use of fungicides can prevent disease outbreaks in turfgrass, but is an expensive and potentially harmful practice. Your local extension agent can help you identify pest problems and select the correct pesticide

INSECTS

When examining turfgrass for insects, look for:

- thinned grass stands,
- dying or dead patches,
- discolored or withered blades,
- chewed or frayed blades,
- frass or webbing,
- small holes, mounds, or burrows, or
- presence of large numbers of bird and animal droppings.

Some insects feed on the blades of grass by sucking, eating or cutting methods, namely: chinch bugs, sod webworms, cutworms, army worms, leafhoppers, aphids and mites.

Other insects feed on grass roots as grubs or maggots and on blades as adults, namely: japanese beetle, may beetle, oriental beetle, asiatic garden beetle, european chafer, masked chafer, wireworm, weevil or bill bug grubs, ants, bees and wasps.

Some of the more troublesome turfgrass insect pests are:

Billbugs and Weevils

Billbugs are small, dark-colored beetles with snouts. Adults lay eggs in turfgrass stems in late spring. The eggs hatch into legless larvae. The larvae eat their way down the stems and into

the crowns. Adults feed on leaves and stems, but are less destructive than the larvae.

Damage shows up in late summer as small dead patches of turfgrass. Damaged plants break off at the crown if pulled on. Damage is similar to that of white grubs. Adults make small holes on grass blades, which become yellow and speckled.

Chinch Bugs

Full-grown chinch bugs are about 1/4 inch long. They are rectangular black bugs with a white area on their back. Turfgrass infested with chinch bugs looks sickly off-color at first, with brown and green blades intermixed. Later, large irregular dead patches show up. Young and adult chinch bugs suck sap from turfgrass blades. The bugs may be found deep in the thatch at the outer edge of the brown patches. Chinch bugs can be found by spreading the dying grass to expose the crowns and roots. Many small bright orange-colored insects barely visible to the naked eye, as well as the large brown insects with white markings can be seen. Damage by these bugs is usually associated with hot, dry weather but can be found in wet weather too.

Sod Webworms

Sod webworm caterpillars are one inch or less in length. They are off-white with parallel rows of small dark spots. The adults are cigar-shaped, buff colored moths. The caterpillars chew off grass stems and leaves above the soil line. Damage shows up as small dead spots.

When many sod webworms are present, the spots join to form large, irregularly-shaped brown patches. Adult sod webworms do not damage turfgrasses but can be seen near light at night. In spring the over-wintering caterpillars feed on the grass. In summer they build silken tunnels at ground level. These tunnels are lined with grass blades and excrement. Sod webworms prefer to attack new lawns.

Grubs

Grubs are the larvae or grubs of hardshelled beetles and chafers. They are white to off-white with a brown head and six legs. Grubs damage grass by eating the roots. Seriously damaged turfgrass can be rolled back like a carpet. When the grass is rolled back, grubs may be found lying in a C-shaped position in the soil.

Grubs are most easily controlled during the time they are actively feeding. The adults lay eggs on the grass and the young grubs will begin feeding in 1 or 2 weeks, continuing until fall when they burrow the ground to overwinter. In spring they come up to the grass roots to feed.

Several beetles are included in this group. The species of grubs can be distinguished and identified by the pattern of spines (rasters) found on the tip of the abdomen.

Japanese Beetle (Popillia, japonica)

Adult is about 1/2 inch long with a shiny metallic-green head and body. Grubs are small with a light brown head. They are common on lawns and turfs.

May Beetle or June Bug (Phyllophaga, spp.)

Adults are brown to black, measure 1/2 inch to 1 inch in length and are attracted to lights at night. The grubs are larger than the japanese beetle grub.

Oriental Beetle (Anomala, orientalis)

Adult is straw-colored with dark spots and is about 1/2 inch long; the grubs are about the size of those of the japanese beetle.

Asiatic Garden Beetle (Autosecrica, castanea)

Adults are light brown in color and 1/4 inch long. Grubs are smaller than those of the japanese beetle and feed from 1 - 3 inch below the soil surface, feeding only on small roots of grass.

European Chafer (Amphimallon, majalis)

Adults are chocolate brown, 1/2 inch long and do little feeding while the grubs feed on the top 1/2 inch soil.

Masked Chafer (Cyclocephala, borealis)

Adults have dark color across the face and about 1/2 inch long. Grubs are larger than those of the japanese beetle and are not too common.

Wireworms

Wireworms are larvae of certain beetles (click-beetles). They are brown to dark and smooth or shiny; occupy the rhizosphere and feed on grass roots.

Green June Beetle (Cotinis, nitida)

These are large green beetles with brown-yellow margins 1 inch long and 1/2 inch wide. Adults feed on trees and other plants while the grubs feed on grass roots in lawns, turfs and on other vegetation. The dirty white grubs crawl along their backs.

Leafhoppers

These are small, pale colored sucking insects that feed on practically all species of plants. Both adults and nymphs feed on plant sap and produce more than two generations a year. Infested lawns appear scorched or wilted.

Aphids

Both adults and nymphs also suck plant sap as the leafhoppers. Feeding retards the growth of lawns.

Mites

They are not insects but are abundant on lawns but do not cause any noticeable damage to grass. They are more of a nuisance when they enter or approach buildings and being considered as household pests.

Ants

Many species of ants infest lawns. These make mounds of earth in the lawn, especially during the dry season, causing the soil to loosen around the roots of grass which eventually dry out. Ants also use grass seeds as food thus preventing propagation.

Bees and Wasps

There are some bees and wasps that build their nests in the ground and in lawns. The females appear in the spring to form a new nest by digging holes and mounding up the soil around the entrance.

Frit Fly

The frit fly is a small, blackish fly found on golf courses. The larvae feed on the stems which turn yellow and die. Adults are a nusiance to humans. Damage is usually on the turf at the edge of putting greens. In winter the larvae goes down to the soil to pupate and overwinter.

Insect Control

Insects that attack turfgrass at or below the soil surface can be controlled only by directing the pesticide at the soil surface and watering it in to contact the pests. Foliage-feeding insects can be controlled by directing the insecticide at the turfgrass foliage. Watering in an application directed at foliage feeders will move the insecticide below the area where the insect pest is feeding and the desired control will be lost. In some areas, preventive applications of insecticides will minimize damage from soil insect pests. More than one pest may be causing damage at the same time. Each may require different timing and placement of insecticide for control. Be sure to consider this when you develop a treatment schedule. Your local extension agent can help you identify pest problems and select the correct pesticide.

Nematodes

Many kinds of nematodes feed on the root of turfgrasses and reduce their vigor. Nematode injury may be confused with nutritional problems, insufficient water, hardpan, or any other factor which restricts root development.

Symptoms of nematode injury include:

o thinning or completely killed areas.

o pale green to yellow color,

o excessive wilting, and

o poor response to fertilization.

The best way to identify nematode problems is with a laboratory examination of soil or plants.

WEEDS

Any plant can be considered a weed if it is growing where it is not wanted. Bentgrass, for example, would be a weed in a bluegrass lawn. To plan a good weed control program, you must:

o identify the desirable turfgrass,

o identify the existing weeds, and

o know what other weeds are likely to become a problem.

Annual Weeds

Annual weeds complete their life cycle in less than one year. Because climatic conditions influence the timing of the life cycle, the correct time for control varies from place to place, year to year and from one species to another. It is often desirable to establish turf in the fall so the freezing weather will control summer annual weeds. In established turfgrass, the chemical control of summer annual weeds after mid-summer may not be necessary or desirable. Summer annual weeds common to turfgrass are:

Broadleaf Weeds	Grass Weeds
common chickweed	crabgrass
henbit	goosegrass
knotweed	barnyardgrass
	foxtail

Winter annuals are common in new turf. After the first year, good

management and a dense turf usually provide satisfactory control.

Example is:

Broad leaf

Common chickweed

Biennial Weeds

Biennial weeds normally occur at the same time as perennial broadleaf weeds. Controls are similar. Example: Wild carrot.

Perennial Weeds

Perennials, both broadleaf and grasses, occur widely as turfgrass weeds. Examples are:

Broadleaf Weeds	Grass Weeds
dandelion	bermudagrass
wild garlic	bentgrass
dichondra	tall fescue
plantain	quackgrass
mouse-ear chickweed	nimblewill
red sorrel	

(nutsedge not a grass, but often considered as one in turfgrass weed control.)

CONTROL

The presence of weeds in turfgrass does not always require the use of herbicides. In areas that contain sensitive plants, it may be better to avoid the use of herbicides than to risk injury. In some locations, any kind of plant cover may be better than dead plants or bare ground. Granular formulations are effective for preemergence herbicides. Sprays are better for postemergence control where foliar coverage is needed.

Broadleaf Weeds

Several postemergence herbicides are used to selectively control annual, biennial, and perennial broadleaf weeds in turfgrasses. They can be used alone or as combinations of more than one active ingredient. Spring and fall applications of post emergence herbicides normally give satisfactory control and reduce the possibility of damage to non-target plants. Young weeds are usually more susceptible to herbicides. Spot treatments are best for scattered weed populations. Weather conditions affect control results.

Grass Weeds--Control of annual grasses is best achieved with:

o preemergence herbicides for general infestations,

o spot treatment with postemergence herbicides for localized infestations.

Few herbicides are safe for use on newly seeded turfgrass. Some preemergence herbicides applied in the spring adversely affect germination of turfgrasses seeded in the fall. Certain varieties of turfgrasses are more prone to injury by some herbicides. Check labels for precautions.

Perennial grass weeds are the most difficult to control. No chemicals will control these weeds without damaging cool season turfgrass. Some chemicals will selectively control them in warm season turfgrass. Soil fumigants and nonselective herbicides are sometimes used.

Brief Description of Some Weeds on Lawns and Turfs

1. Ground Ivy (Nepeta hederacea) is a dense, creeping weed which invades turf and causes unsightly patches. It grows well on poorly drained or shady turf areas. Ground ivy has four-sided stems that grow along the ground and root at the joints. The bright green leaves are round with scalloped edges. They range in size from 1/2 to 1-1/2 inches in diameter. The flowers at the base of the leaves are small and bluish-purple. Control is extremely difficult and must be done in the early spring and fall helps reduce infestation.
2. Dandelion is easily recognized by its sharp lobed leaves. Its flowers are bright yellow and turn into a fluffy white seed head.
3. Buckhorn Plantain (Plantago lanceolata) is a flat growing plant with bullet-like seed heads on long, slender stems. Control is done during the active growing season.
4. Broadleaf Plantain (Plantago major) has large, oval-shaped leaves and a pencil-like seed head. It can be controlled when the plant is growing fast in the early spring or fall. It is easily controlled when the plant is in active growth.
5. Broadleaf Plantain has broad shiny green leaves. It sends up a heavily seeded stalk to a maximum height of 12 inches.
6. Common Chickweed (Stellaria media) is a creeping winter annual. When infestations are heavy it covers the ground like a net. Common chickweed has small, pale green leaves. It has hairy stems which branch and take root. This allows the plant to spread over large areas. Common chickweed has star shaped white flowers that may be

produced all winter. Chickweek can be controlled when the weed is growing fast.

7. Knotweed (Polygonum aviculare) is low growing and has small bluish leaves. Knotweed grows well in compacted soils. Knotweed has smooth bluish-green leaves. The stems often spread along the ground but they do not take root. Knotweed has incospicuous white flowers that appear at the base of the leaves. The weed can be controlled in late spring to mid-summer.
8. Sheep Sorrel (Rumex acetosella) is a clump type weed with pointed leaves. It often appears if the soil is too acid or too low in nitrogen. The weed will generally disappear when this soil condition is corrected. Sheep sorrel has arrow shaped leaves which have a sour taste. If left unmowed sheep sorrel can produce a stalk up to 2 feet in height.
9. White Clover (Trifolium repens) can smother established turfgrasses. White clover is identified by its three short-stalked leaflets. It produces round, white flowers which are raised on smooth stems. Its leafless stems look unsightly in the winter. Control in spring or fall.
10. Crabgrass (Digitaria ischaemum and Digitaria sanguinalis) is a late germinating grass-like weed. Its horizontal type the ground and roots at the joints of the stems. Crabgrass has finger-like seed heads. Crabgrass is killed by the first hard frost. But it can be controlled by pre-and post emergent weedicides.
11. Quackgrass (Agrapyron repens) is a grass weed with a dull green color. It spreads mostly by rhizomes, but can produce seeds. There is no selective chemical which will control quackgrass.

12. Heal-all (Prunella vulgaris) is a spreading type weed that is identified by its purple flower. The weed also has a four-sided stem.

13. Nimblewill (Muhlenbergia schreberia) is a creeping, grass-like weed that forms dense patches. The tops of these patches are killed by frost and the straw color will last until late spring. During the summer, nimblewill has a gray-green color. Nimblewill has wiry stems with short flat leaf blades. Neither the stems nor the leaf blades are hairy. The stems root at the joints when they come in contact with soil. There is no selective chemical control for nimblewill.

14. Bull Thistle (Cirsium vulgare) is a perennial weed with very spiny leaves. Bull thistle appears as a single plant, but can spread by underground stems. Bull thistle is very easily identified by its spiny leaves. It is controlled well when the plant is in active growth.

15. Curly Dock (Rumex crispus) is a perennial weed. It has broad smooth leaves. If left uncut, curly dock will produce an upright stem which may reach a height of 3 feet. Curly Dock is identified by its leaves which have crinkled edges and a prominent mid-vein.

16. Ox-eye Daisy (Chrysanthemum leucanthemum) is a perennial weed which spreads by seeds and rhizomes. It can produce an upright stalk with yellow and white flowers. In early stages of growth, ox-eye daisy can be controlled.

17. Purslane (Portulaca oleracea) is a fleshy annual weed which germinates in the spring. It bears red flowers from July until the plants are killed by frost. Purslane is not too aggressive and generally would not move in where there is a well established turf. Purslane can be

recognized easily by its thick, fleshy type of growth. Purslane can be controlled when the plant is growing rapidly.

18. Oxalis (Oxalis stricta) is a pale green, perennial weed. Its stems spread but they usually do not take root. Oxalis has clover-like leaves, which have a distinctive sour tast. The flowers are yellow with five petals. There is no selective chemical control for oxalis.

19. Tall Fescu (Festuca elatior 'arundiances') is a valuable grass plant when used in the proper place, but when growing out of place it is considered a weed. It has an unsightly appearance when mixed with a finer textured type grass. There is no selective chemical control for Tall Fescue.

20. Goosegrass, Silver Crab (Eleusine indica) appears much like crabgrass except that the center of the weed has a silvery color. Unlike crabgrass the stems of goosegrass do not take root. Goosegrass is controlled best by improving soil conditions for turf growth.

21. Yellow Foxtail (Setaria glauca) is another weed that resembles crabgrass, but it does not tend to creep. Foxtail is often found in new lawns and tends to disappear as the turf thickens.

22. Yellow Rocket, or Winter Cress (Barbarea vulgaris) is usually found in new or poorly maintained turf. It is a perennial weed that will produce an upright stem with yellow flowers. Yellow Rocket is identified by its irregular shaped leaves which are shiny and have large terminal lobes. Yellow rocket can be controlled in the spring or fall.

23. Yarrow (Archillea millefolium) is a fern-like, perennial weed that spreads by underground rootstocks. Under close clipping it forms a dense mat and is quite wear resistant and tolerant to drought.

Vertebrate Pests

Vertebrate animals may damage large areas of turf while they are searching for grubs or other soil-infesting insects. They include:

o mice

o skunks,

o moles,

o squirrels, and

o birds,

Control of turf-damaging insects also helps control damage by vertebrate animals, because it reduces their food supply.

* Dogs are a menace to lawns and turf. They destroy the grass mechanically by digging or tramping constantly. Chemically their feces and urine do more damage.

PHYTOTOXICITY

Phytotoxicity is undersirable injury to plants. Symptoms of which include:

o stunting,

o overgrowth,

o discolored foliage, and

o stem distortion

The cause of phytotoxicity may be easy to determine or it may be subtle and hidden. Pesticides can cause phytotoxicity. Other causes that create similar symptoms are:

o insects and disease agents,

o insufficient moisture,

o improper fertilization, and

o other adverse growing conditions.

Factors that contribute to pesticide phytotoxicity include:

o high air temperature during and immediately after pesticide application,

o excessive rates of pesticide application,

o too little water,

o uneven distribution of pesticide,

o variety and species differences.

Take special care to avoid injury to lawns and turfs when using herbicides. Some herbicides leave residues in spray tanks that will injure desirable plants. Use separate sprayers for herbicides.

ENVIRONMENTAL CONCERNS

To control drift and vaporization:

o Apply pesticides when wind speeds are low.

o Use lowest practical operating pressure and largest practical nozzle opening.

o Keep nozzle as close to target as possible.

o Avoid using airblast sprayers and dusters when working near sensitive plants and areas inhabited by animals.

o Do not apply herbicides with airblast sprayers.

o When possible, select products with low volatility.

To control the adverse effects of pesticide movement:

o Use special precautions when using pesticides on slopes.

o Select the least hazardous pesticide that will do the job.

o Use minimum does, mulches, and, if possible, maintain a buffer area between the area to be treated and sensitive areas.

o Consider the chances of heavy rainfall.

o Regulate the amount and duration or irrigation.

o Be aware of the potential for ground water contamination.

o Avoid carrying treated material or the pesticide residue from the target area to adjacent areas.

Applicators must be familiar with the persistence of pesticides they apply to lawns and turfs especially where:

o adjacent areas may be affected,

o treated soil is used to grow other plants, or

o humans, pets, or other animals are present

Repeated applications of some pesticides to the same area may cause harmful residues.

Application

Methods of application vary with:

o the kind of pesticide,

o the host, and

o the target pest.

Application equipment must be able to deliver a thorough coverage of the correct amount of pesticide to the plant parts which need protection.

Low pressure, low volume sprayers or granular applicators can be used for control of:

o diseases or insects on lawns, turfs, or

o weeds.

High pressure hydraulic or air blast sprayers are not often used on lawns and turfs.

Protecting Animals and People

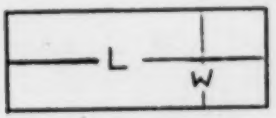
Keep away animals and people during application, and until spray has dried or dust has settled. Keep them away from areas of potential drift and runoff. Remove toys, pet food dishes, bird-feeders, and other articles from the site before applying a pesticide. Do not use pesticides when people or pets cannot be excluded during the re-entry period specified on the label.

AREA MEASUREMENTS

Calibration of equipment depends on your ability to measure the area

to be treated. If the area is a rectangle, circle or triangle, simple formulae may be used.

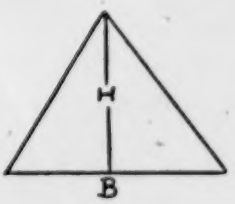
Rectangles: The area of rectangle is found by multiplying the length by the width. Area = length x width



Circles: The area of a circle is the radius (one half the diameter) squared and then multiplied by 3.14 Area = 3.14 the radius squared.

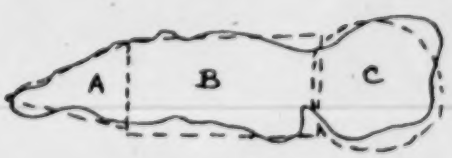
Triangles: The area of a triangle is one-half the base multiplied by the height.

$$\text{Area} = \frac{b \times h}{2}$$



Irregularly shaped turf areas often can be reduced to one or more of these common shapes. Calculate the area of each and add them together to obtain the total area.

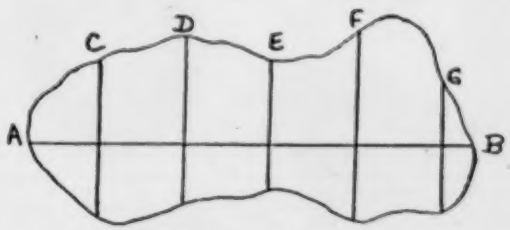
Example:



Area A + B + C = Total Area

Another way is to establish a line down the middle of the property for the length, and then measure from side to side at several points along this line. Areas with very irregular shape require more side to side measurements. The average of the side measurements can be used as the width. The area is then calculated as a rectangle. (Area = Length x Width)

Example:

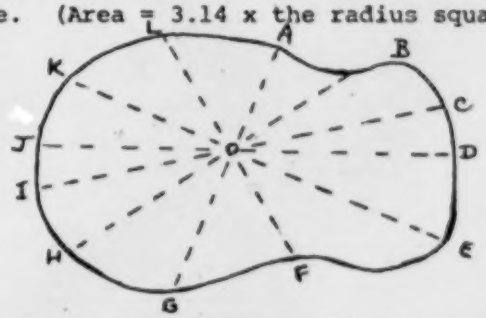


Length = line AB

$$\text{Width} = \frac{\text{line C + D + E + F + G}}{5}$$

A third method is to convert the area into a circle. From a center point measure distance to the edge of the area in 10 to 20 increments. Average these measurements to find the average radius. Then calculate the area using formula for a circle. (Area = 3.14 x the radius squared).

Example:



$$\text{Area} = \frac{(3.14 \times \text{Line A + B + C + D + E + F + G + H + I + J + K + L})}{12}$$

Weights and Measures

Weights

1 ounce	=	28.35 grams
16 ounces	=	1 pound = 453.59 grams
1 gallon water	=	8.34 pounds = 3.785 liters = 3.78 kilograms of wettable powder
1 pound per 100 gallons	=	1 tablespoon per gallon (approx.)

Liquid Measures

1 fluid ounce	=	2 tablespoons = 29.573 milliliters
16 fluid ounces	=	1 pint = 0.473 liters
2 pints	=	1 quart = 0.946 liters
8 pints = 4 quarts	=	1 gallon = 3.785 liters

1 pint emulsifiable concentrate per 100 gallons = 1 teaspoon per gallon

Length

1 foot	=	30.48 centimeters
3 feet	=	1 yard = 0.9144 meters
16 1/2 feet	=	1 rod = 5.029 meters
5,280	=	320 rods = 1 mile = 1.6 kilometers

Area

1 square foot	=	329.03 cm
9 square feet	=	1 square yard = 0.836 square meter
43,560 square feet	=	160 square rods = 1 acre = 0.405 hectare

Speed

1.466 feet per second	=	88 feet per minute = 1 mph = 1.6 kilometers per hour (kph)

Volume

27 cubic feet	=	1 cubic yard = 0.765 cubic meter
1 cubic foot	=	7.5 gallons = 28.317 cubic decimeters

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